



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>6</sup> : <b>C12C 11/00, C12H 1/06, C12G 3/08</b>		<b>A1</b>	(11) International Publication Number: <b>WO 97/44436</b>
			(43) International Publication Date: 27 November 1997 (27.11.97)
(21) International Application Number: <b>PCT/IE97/00039</b> (22) International Filing Date: 22 May 1997 (22.05.97) (30) Priority Data: 960360                      23 May 1996 (23.05.96)                      IE (71) Applicant (for all designated States except US): <b>VALDOSA LIMITED [IE/IE]; 90 South Mall, Cork (IE).</b> (72) Inventor; and (75) Inventor/Applicant (for US only): <b>JOHNS, Colin [IE/IE]; 24 Calderwood Drive, Douglas, Cork (IE).</b> (74) Agents: <b>O'CONNOR, Donal, H. et al.; Cruickshank &amp; Co., 1 Holles Street, Dublin 2 (IE).</b>		(81) Designated States: <b>AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DE (Utility model), DK, DK (Utility model), EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</b>  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	
(54) Title: <b>A BREWING PROCESS</b>			
(57) Abstract <p>Malt and roasted barley are mixed with hot water in a mash tun. The brew is transferred to a lauter tun to separate the sweet wort which is boiled and hops are added. The sweet wort is cooled and then fermented with yeast to form stout. A plate filter (1) is used to substantially clarify the stout. The flow of beer from a storage vessel (2) is monitored by a flowmeter (3) and the oxygen content is monitored by an analyser (4). Beer is delivered from a balance tank (5) to the filter (1) and bright diluted beer from the filter (1) is collected in a buffer vessel (7). A control valve (10) with a feedback control loop is used to control the flow of bright stout from the vessel (7).</p>			

**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

- 1 -

**"A Brewing Process"**

The invention relates to a stout brewing process.

There are considerable technical difficulties in producing high quality stout having desired properties. A complex series of variables are involved in the production process and it is difficult to reproduce the production process from one production site to another.

One particular area of difficulty is in removing unwanted particulates from the stout. It is known to use centrifuges for this purpose. However, the capacity of such centrifuges is limited and it is often difficult to optimise the operation of the centrifuges.

The invention is therefore directed towards providing an improved process for producing stout which will overcome at least some of these difficulties.

According to the invention, there is provided a stout brewing process comprising the steps of:-

preparing malt by cleaning, weighing, and milling malt;

preparing roasted barley by cleaning, weighing and milling roasted barley;

mixing the prepared malt, the prepared roasted barley and hot water in a mash tun to prepare a brew;

preparing sweet wort by agitating the brew and allowing starch in the brew to convert to sugar by enzymatic activity;

- 2 -

separating spent grains of malt and roasted barley  
from the sweet wort;

boiling the sweet wort;

5 adding hops to the boiling sweet wort to prepare  
hopped wort;

removing hop residues from the hopped wort;

cooling the hopped wort;

10 adding yeast and sterile air to the hopped wort and  
allowing the mixture thus formed to ferment to  
produce stout;

blending and storing the stout;

monitoring the oxygen content of the stout;

applying a precoat material to a plate filter;

15 passing the stout through the precoated plate filter  
to substantially clarify the stout by removing  
particulates from the stout and forming bright  
diluted stout;

controlling the carbon dioxide content of the stout;

controlling the nitrogen content of the stout; and

20 storing the stout.

In a particularly preferred embodiment of the invention,  
the process includes the step of adding bodyfeed material  
to the stout in-line upstream of the precoated plate

- 3 -

filter.

In a preferred embodiment of the invention, the process includes the steps of:-

5       delivering the bright filtered stout into a bright stout buffer tank prior to delivery to a main bright stout storage tank; and

controlling the level of bright stout in the buffer tank to maintain a substantially constant pressure drop across the plate filter.

10       In this case, preferably the level of bright stout in the buffer tank is controlled by reducing the rate of flow of bright stout from the buffer tank if the level of bright stout drops below a preset level.

15       Preferably, the storage stout is delivered into an unfiltered stout buffer tank upstream of the plate filter. In this case, preferably the process includes the step of controlling the level of unfiltered stout in the buffer tank to maintain a substantially constant pressure drop across the filter.

20       In a preferred arrangement, the amount of oxygen in the stout is monitored both upstream and downstream of the plate filter.

25       Preferably, the process includes the step of monitoring the alcohol content of the filtered bright stout and injecting dilution water into the bright stout as required to achieve a desired alcohol content.

The invention will be more clearly understood from the following description thereof, given by way of example

- 4 -

only, with reference to the accompanying drawings, in which:-

Fig. 1 is a schematic block diagram of the process of the invention; and

5        Fig. 2 is a schematic flow diagram illustrating filtration and associated steps in the process of the invention.

Referring to the drawings, and initially to Fig. 1, there is illustrated a brewing process for stout according to  
10        the invention. In the brewing process, malt and roasted barley are separately stored in silos and are then cleaned and subsequently weighed prior to milling. The malt and roasted barley are then mixed with hot water in a mash  
15        tun. The brew is transferred to a lauter tun to separate the sweet wort. Spent grains of malt and roasted barley are then removed. The sweet wort is then pumped to a wort copper where it is boiled and hops are added. The hopped  
20        wort is then pumped to a whirlpool where hop residues are drained away. At this stage, the sweet wort is still hot and it is then pumped to a heat exchanger where it is cooled. The cooled sweet wort is then pumped to a fermentation vessel where yeast and sterile air are added and it is allowed to ferment to form stout. The stout is then blended and stored in a storage tank to allow it to  
25        mature.

In the process of the invention, the stout is clarified as will be described in more detail below. The carbon dioxide and nitrogen levels in the stout are controlled and the stout is then stored, ready for delivery into  
30        barrels, as required.

- 5 -

In the process of the invention, Murphy's Irish Stout Yeast having the following characteristics is added to the cooled sweet wort in the fermentation vessel.

5	Microbiological plate characteristics	-	No growth on Wort Agar @ 37°C, SDA+, Lys and Cu.
		-	No Melibiase activity.
		-	No killer yeast activity.
10		-	No Phenolic flavour production.
	Fermentation characteristics	-	Has some characteristics of both top and bottom fermenting yeasts.
15		-	After two days fermentation it floats on the liquid surface and at the end of the fermentation it settles rapidly.
20		-	Highly hydrophobic and flocculent (ABS/min 0.8 - 1.0).
25	Dextrin degradation	-	No activity.
	Aroma profile	-	Low SO <sub>2</sub> production.
		-	Slightly low ester production.
30		-	Slightly high production of higher alcohols.
		-	No 4 - VG or styrene production.
35	Giant colony morphology	-	95% dark green malt colony type with pseudohyphale.
		-	5% small white edged/green centre colony type.

- 6 -

Referring to Fig. 2, in the process of the invention a plate filter 1 is used to substantially clarify the stout by removing particulates from the stout and forming bright diluted stout.

5 Stout to be clarified is stored in a storage beer vessel 2. The flow of beer from the vessel 2 is monitored by a flowmeter 3 and the oxygen content of the beer is monitored by an oxygen analyser 4. The beer is delivered into a balance tank 5 which is held at a pressure of  
10 approximately 0.7 bar. The level of unfiltered stout in the balance tank 5 is controlled to maintain a substantially constant pressure drop across the filter 1. Bright diluted beer from the plate filter 1 is collected in a buffer vessel 7, held at approximately 0.5 bar  
15 pressure. The oxygen content of the bright beer delivered into the buffer vessel 7 is monitored by a second oxygen analyser 8. The level of bright stout in the buffer tank is controlled to maintain a substantially constant pressure drop across the plate filter 1 and hence optimise  
20 the operation of the filter 1. The level of bright stout in the buffer tank is controlled by reducing the rate of flow of bright stout from the buffer vessel 7 if the level of bright stout drops below a preset level. A control valve 10 with a feedback control loop to a level detector  
25 is used to control the flow of bright stout from the buffer vessel 7.

The rate of flow of bright stout from the buffer vessel 7 is monitored by a flowmeter 11. The alcohol content of the stout is also monitored by an alcohol analyser 12. If  
30 the amount of alcohol present in the bright stout is above a predetermined value, a control valve 13 on a dilution water flow line 14 is activated. The flow of dilution water is monitored by a further flow meter 15.



- 7 -

In this way, the amount of dilution water added is closely controlled to achieve the desired alcohol content in the bright stout. The bright stout having, if necessary, been diluted with water to achieve a uniform desired alcohol content is delivered into a storage vessel 18 for further processing.

The filter plates of the plate filter 1 are first coated by applying a precoat material to the filter plates from a make-up vessel 20 through a precoat delivery line 21. Bodyfeed material is added to the stout in-line upstream of the precoated plate filter 1 through a body feed delivery line 22.

**EXAMPLE**

The stout was filtered using a ZHF/Z kieselguhr horizontal plate filter available from Schenk Fiterbaum GmbH of Germany. The filter had the following features:-

	filter elements:	approx. 46m <sup>2</sup>
	spacing between elements:	35 mm
	sludge volume:	1,500 litres
20	precoat material:	approx 45.4 Kg of Celite 5C available from Celite Corporation
25	Bodyfeed added to stout	approx. 45.4 Kg of Celite Standard SUPERCEL mixed with approx. 22.7 Kg of Celite 577, both available from Celite Corporation.
30	Dilution Target:	9.4°P

- 8 -

	Time (Mins)	Prefilter Pressure (Bar)	Post Filter Pressure (Bar)	Flow Rate through filter hl/hr	Oxygen Content of Dilution Water (ppb)	Alcohol Level (% vol)	Total Filtered (hectalitres)
5	0	3.0	0.9	430.6	21	4.0	-
	3	2.9	0.7	438.2	22	4.1	88.0
10	12	3.2	0.9	360.0	23	4.0	173.4
	21	3.1	0.7	362.1	23	4.1	-
	26	3.2	0.8	358.5	25	4.0	240.5
15	29	Chase Water					

	Recirculation Time:	34 minutes
	Total Filtration Time:	29 minutes
20	Run Out Time:	45 minutes
	Final Water Volume:	57.3 HL's
	Final Stout Volume:	276.3 HL's
	Total Volume to Bright Stout Tank:	333.6 HL's

25 The bright stout thus produced had excellent properties of uniform alcohol content, colour, pH, dissolved CO<sub>2</sub>, visual clarity, yeast content, taste and aroma.

The invention is not limited to the embodiments hereinbefore described which may be varied in detail.

- 9 -

**CLAIMS**

1. A stout brewing process comprising the steps of:-

preparing malt by cleaning, weighing, and  
milling malt;

5 preparing roasted barley by cleaning, weighing  
and milling roasted barley;

mixing the prepared malt, the prepared roasted  
barley and hot water in a mash tun to prepare a  
brew;

10 preparing sweet wort by agitating the brew and  
allowing starch in the brew to convert to sugar  
by enzymatic activity;

separating spent grains of malt and roasted  
barley from the sweet wort;

15 boiling the sweet wort;

adding hops to the boiling sweet wort to prepare  
hopped wort;

removing hop residues from the hopped wort;

cooling the hopped wort;

20 adding yeast and sterile air to the hopped wort  
and allowing the mixture thus formed to ferment  
to produce stout;

blending and storing the stout;

- 10 -

monitoring the oxygen content of the stout;

applying a precoat material to a plate filter;

5        passing the stout through the precoated plate  
filter to substantially clarify the stout by  
removing particulates from the stout and forming  
bright diluted stout;

controlling the carbon dioxide content of the  
stout;

10        controlling the nitrogen content of the stout;  
and

storing the stout.

2.    A process as claimed in claim 1 including the step of  
adding bodyfeed material to the stout in-line  
upstream of the precoated plate filter.

15    3.    A process as claimed in claim 1 or 2 including the  
steps of:-

delivering the bright filtered stout into a  
bright stout buffer tank prior to delivery to a  
main bright stout storage tank; and

20        controlling the level of bright stout in the  
buffer tank to maintain a substantially constant  
pressure drop across the plate filter.

25        4.    A process as claimed in claim 3 wherein the level of  
bright stout in the buffer tank is controlled by  
reducing the rate of flow of bright stout from the  
buffer tank if the level of bright stout drops below

- 11 -

a preset level.

5. A process as claimed in any preceding claim wherein the storage stout is delivered into an unfiltered stout buffer tank upstream of the plate filter.
- 5 6. A process as claimed in claim 5 including the step of controlling the level of unfiltered stout in the buffer tank to maintain a substantially constant pressure drop across the filter.
- 10 7. A process as claimed in any preceding claim wherein the amount of oxygen in the stout is monitored both upstream and downstream of the plate filter.
- 15 8. A process as claimed in any preceding claim including the step of monitoring the alcohol content of the filtered bright stout and injecting dilution water into the bright stout as required to achieve a desired alcohol content.
9. A process as claimed in any preceding claim wherein the yeast added to the hopped wort has the characteristics set out in Table 1 herein.
- 20 10. A process for producing stout substantially as hereinbefore described with reference to the accompanying drawings and examples.
11. Stout whenever produced by a process as claimed in any preceding claim.

1 / 2

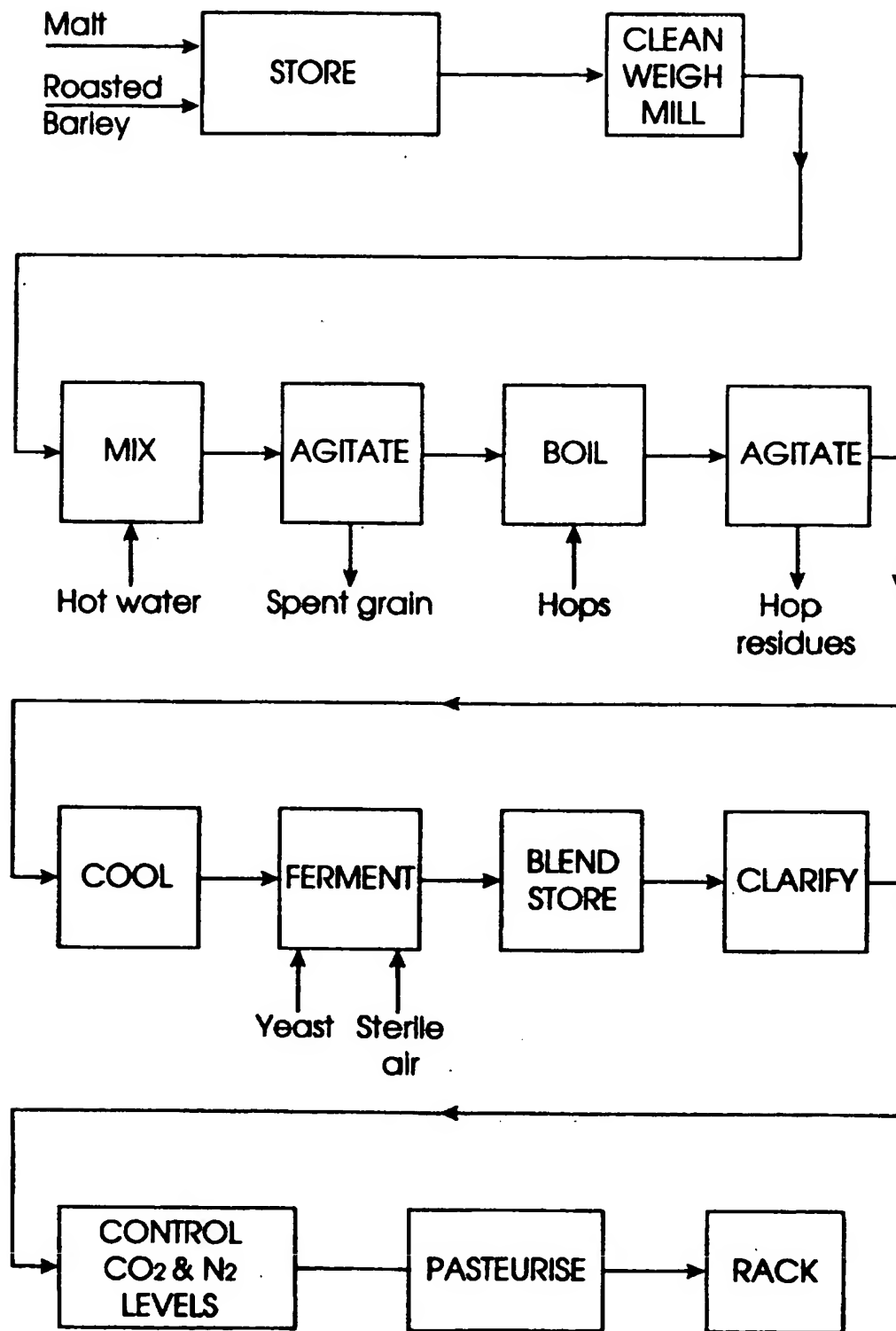
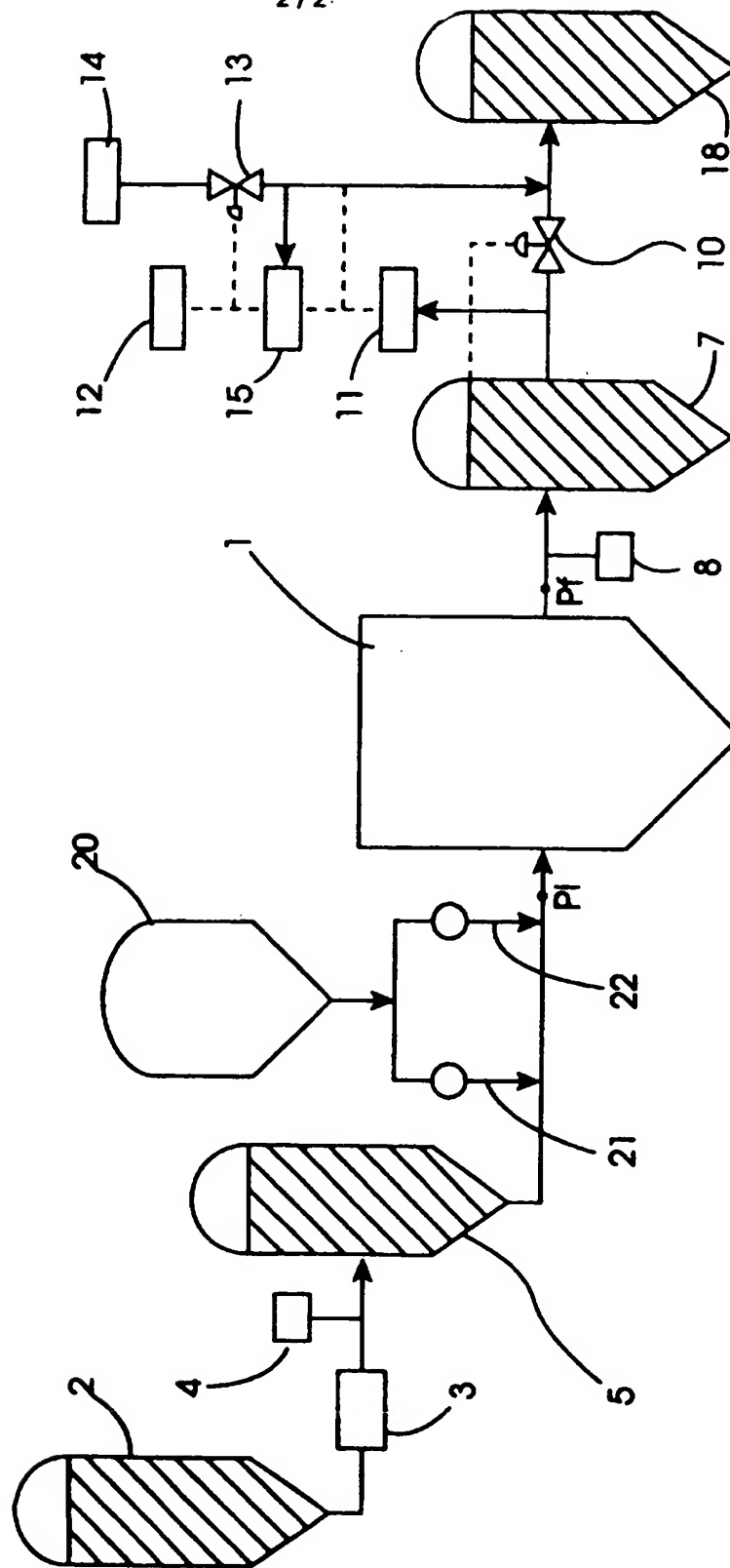


Fig. 1



**Fig. 2**

# INTERNATIONAL SEARCH REPORT

International Application No. . . .

PCT/IE 97/00039

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 C12C11/00 C12H1/06 C12G3/08

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 C12C C12H C12G B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	BE 1 001 787 A (MURPHY BREWERY RESEARCH AND DEVELOPMENT LIMITED) 6 March 1990 see the whole document ---	1,7
Y	CARPENTER, P.M.: "Analysis and quality control of beers and lagers during and after processing." ANALYTICAL PROCEEDINGS, vol. 17, no. 5, 1980, UK, pages 195-196, XP002044090 see page 196, paragraph 3 - paragraph 7 ---	1,7
A	GB 2 190 603 A (SEITZ ENZINGER NOLL MASCHINENBAU AKTIENGESELLSCHAFT) 25 November 1987 see page 1, column 2, line 90 - line 122; claims --- -/-	1,3,6

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"Z" document member of the same patent family

Date of the actual completion of the international search

21 October 1997

Date of mailing of the international search report

10.11.97

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Bevan, S



# INTERNATIONAL SEARCH REPORT

Intern. Application No.

PCT/IE 97/00039

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 489 024 A (S.F. BOWSER & COMPANY, INC.) 18 August 1938 see page 5, line 116 - page 6, line 120; claims ---	1,3
A	US 4 396 505 A (D.H. WILLSON & T.C. ADAMS) 2 August 1983 see column 3, line 38 - column 4, line 37 ---	3,4,6
A	GB 2 270 525 A (MOLSON BREWERIES) 16 March 1994 see page 8, paragraph 2 -----	8

# INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern. Patent Application No

PCT/IE 97/00039

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
BE 1001787 A	06-03-90	NONE	
GB 2190603 A	25-11-87	DE 3617519 A CH 672602 A	26-11-87 15-12-89
GB 489024 A		NONE	
US 4396505 A	02-08-83	NONE	
GB 2270525 A	16-03-94	CA 2077584 A AU 676180 B AU 4614593 A	05-03-94 06-03-97 10-03-94